

ACCESSION NR: AT4025306

S/0000/63/000/000/0163/0172

AUTHORS: Kalmykov, A. A.; Timofeyev, A. D.; Pankrat'yev, Yu. I.;
Nozdrachev, M. G.

TITLE: Investigation of a plasma source with the aid of a through
passage mass spectrometer

SOURCE: Diagnostika plazmy* (Plasma diagnostics); sb. statey.
Moscow, Gosatomizdat, 1963, 163-172

TOPIC TAGS: mass spectrometer, plasma source, plasmoid, plasmoid
acceleration, plasma injection, ion separation

ABSTRACT: In view of the lack of information on the internal struc-
ture of plasmoids and of a satisfactory description of the mechanism
of plasma acceleration in different plasma guns, and in view of the
difficulty of interpreting the experimental results on interaction
between plasmoids and magnetic fields owing to the lack of this in-

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ACCESSION NR: AT4025306

formation, a method is proposed wherein more detailed microscopic characteristics can be obtained with the aid of through-passage mass spectrometer. This mass spectrometer was used to investigate the mass and energy spectra of plasmoids from a Bostick gun (W. H. Bostick, Phys. Rev. v. 104, 2, 292, 1956). The operation of all the units of the instrument is described in detail in a separate article (Pribery* i tekhnika eksperimenta, in press). The conditions for optimal mass separation are described. In view of the short transit time employed, there is no need for additional modulation. The apparatus yields mass spectra of ions of given energy, from which the energy spectra of particles having different masses can be plotted. The angular distributions of the ions of different masses and energies were also investigated and it was found that ions with larger velocities form a narrower velocity cone than the slower ions. It is therefore concluded that measurement of the true energy distribution must be accompanied by measurement of the angular distribution of the particles and the number of particles of given energy must be

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ACCESSION NR: AT4025306

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integrated over all the angles in order to ensure accuracy. The duration of the discharge exerts little influence on the energy spectra. The length of the plasmoid changes as it moves from the source because of the spread in particle velocity, and since the particle velocity decreases with increasing mass, the light ions are concentrated in the frontal part of the plasmoid and the heavy ones in the tail part. This spatial separation of the ions increases with increasing transit length. In the absence of the magnetic field the slow ions are rapidly lost because of the broad velocity cone. There are grounds for assuming that the plasmoids produced by other plasma guns, particularly coaxial, show a similar behavior. Orig. art. has: 9 figures.

ASSOCIATION: None

SUBMITTED: 19Oct63

DATE ACQ: . 16Apr64

ENCL: 00

SUB CODE: NP, ME

NR REF SOV: 003

OTHER: 003

Card 3/3

L 23521-65 HEO(b)-2/EPA(w)-2/ENG(x)/ENT(1)/REC(t)/EPA(sp)-2/ET/ENT(m)-2
PI-4/PO-4/PE-6/PAB-10 IJP(o) AT

ACCESSION NR A 4046664

S/0185/84/000/009/1021/1025

AUTHOR: Kalmykov, A. O. Marynin, V. G. Sytnov, F. V.
AS INDEXED

TI LE: Effect of the electrode geometry of coaxial symmetry on the parameters
of plasma condensations

SOURCE: Ukrayins'kyi fizychnyy zhurnal, v. 9, no. 9, 1964, 1023-1025

TOPIC TAGS: plasma, coaxial electrode, magnetic trap, electrode geometry

Card 12

L 23521-65
ACCESSION NR: AP4046004

ma composition was studied with a mass spectrograph, the total energy of particles with a calorimeter. The energy distribution, the mass composition and the

ASSOCIATION: Fiziko-tekhnicheskyy Institut AN URSS
Technical Institute AN URSS)

Kharkiv (Physical

SUBMITTED: 12Mar84

ENCL: 00

SUB CODE WE. EM

NO REF SOV. 002

OTHER: 004

2/2

ACCESSION NR: AP4040301

S/0057/64/034/006/1005/1010

AUTHOR: Kalmykov, A.A.; Trubchaninov, S.A.; Naboka, V.A.; Zlatopol'skiy, L.A.

TITLE: Structure and energy spectra of plasma bursts from a coaxial plasma gun

SOURCE: Zhurnal tekhnicheskoy fiziki, v.34, no.6, 1964, 1005-1010

TOPIC TAGS: plasma, plasma source, plasma jet, plasma concentration

ABSTRACT: The mass and energy spectra of the ions in the plasma bursts from a coaxial plasma gun were determined with a time of flight mass spectrometer and electrostatic analyzer described elsewhere (A.A.Kalmykov, A.D.Timofeyev et al, PTE, No.5, .142, 1963). The attenuation of 3 cm and 8 mm microwaves by the bursts was also observed, and the visible radiation was recorded with a photomultiplier. The plasma gun was 17.5 cm long, and the coaxial cylindrical electrodes were 3 and 7.5 cm in diameter. The gun was powered by a 12 microfarad capacitor charged to 10 to 20 kV, and the period of the circuit was 7 microsec. Approximately 1 cm³ of hydrogen (standard conditions) was admitted to the gun through a pulsed valve. Two quite different modes of operation were noted, depending on the delay between admitting the gas and firing the gun. When this delay was greater than a certain critical value,

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ACCESSION NR: AP4040301

a single dense burst was ejected at a velocity of about 10^7 cm/sec. The density of this burst was at least 10^{14} cm⁻³, but it contained no ions with energies greater than 100 eV. The operation under these conditions was not investigated in detail, but it appeared to conform to the theory of L.C.Burkhard and R.H.Loveberg (Phys.Fluids 53,341,1962). When the delay was less than the critical value, two bursts were ejected, of which the more rapid had a density of 10^{13} cm⁻³ and contained ions with energies up to 20 keV. The energy spectra of these bursts varied only slightly when other operating conditions were changed, provided only the delay time remained less than the critical value. The ions were all accelerated simultaneously (within 0.5 microsec) during the first half cycle. The moment of origin of the ions was marked by a slight but very sudden decrease of the discharge current, occurring near the first peak. Heavy impurity ions, presumably originating in the insulation and the valve packing, were present in considerable numbers. These had the same energy distribution as the protons, and hence smaller velocities. The burst could therefore in principle be purified by permitting it to drift a sufficient distance. In the absence of a magnetic field (all the work reported was performed with no longitudinal magnetic field) nearly all the low energy ions, and none of the high energy ions, were lost during traversal of one meter. This is presumably due to the better collimation of the high energy ions. It is suggested that the difference between the two

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ACCESSION NR: AP4040301

modes of operation is due to the interaction of the charged particles at high densities: when the delay time is short the density is moderate and the particles are accelerated essentially individually; when the delay time is long the density is sufficient for the interactions to become important, and they may be taken into account by a magnetohydrodynamic theory such as that of Burkhard and Loveberg (loc. cit.). "In conclusion, the authors consider it a pleasant duty to express their gratitude to B.G.Safronov for fruitful discussions and his interest in the work." Orig.art.has: 6 figures and 1 table.

ASSOCIATION: none

SUBMITTED: 22Jul63

DATE ACQ: 19Jun64

ENCL: 00

SUB CODE: ME

NR REF SOV: 003

OTHER: 002

Card 3/3

AUTHOR: Kalmykov, A.A.; Toreshin, V.I.; Poltavskiy, N.S.

TITLE: Investigation of the energy spectra of a conical electrode plasma source

SOURCE: Zhurnal tekhnicheskoy fiziki, v.34, no.8, 1964, 1424-1431

TOPIC TAGS: plasma source, particle spectrum, energy distribution, mass spectrometry, hydrogen plasma

ABSTRACT: Whereas the usual investigations of plasma bursts from different pulsed sources yield information only on the macroscopic characteristics, i.e., the values of the volume of the burst, it is also of interest to know the energy of

conductor and pulsed

Card 1/3

L 20217-65
ACCRSSION NR: AP4042929

two different operating conditions of the source, determined by the lag time between the initiation of the discharge and the beginning of admission of the gas (0.05 to 1.0 cm³·atm hydrogen at a pressure of about 2 atm). The

ASSOCIATION: none

SUBMITTED: 27Nov63

SUB CODE: ME, HP

RUM NOV: 002

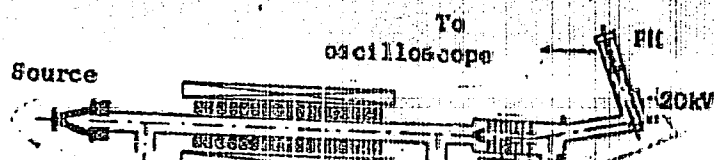
INCL: 01

CIPHER: 011

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L 20217-65
ACCESSION NR: AP4042829

ENCLOSURE: 01



Analyzer
To pump
To pump
To pump

Fig. 1. Diagram of the setup

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L 15241-65 ENT(1)/ENG(k)/EPA(ad)-2/EPA(w)-2/EEG(t)/T/EEG(d)-2/WT(m)-2 Pt-1/
Pi-1/Pz-6/Pab-10 IJP(c)/ESD(gs)/ESD(t)/AEDC(b)/SSD(b)/ASD(b)-3/RETH(e) AT

ACCESSION NR: AP4045271

S/0057/64/034/009/1605/1612

AUTHOR: Kalmykov, A.A.; Tereshin, V.I.

TITLE: Interaction of high-density plasma bursts with a spatially periodic magnetic field

SOURCE: Zhurnal tekhnicheskoy fiziki, v.34, no. 9, 1964, 1605-1612

TOPIC TAGS: plasmoid, plasma trapping, plasma burst

ABSTRACT: In a preceding study, the authors' group (A.A. Kalmykov, V.I. Tereshin, S. A. Trubchaninov, and V.G. Safonov, ZhTF, 32, 579, 1962) investigated the interaction of low-density (10^{15} - 10^{16} m⁻³) plasmoids (plasma bursts) with spatially periodic (space-modulated, rather than continuous) magnetic fields and showed that when the condition for particular parametric resonance is satisfied, significant redistribution of energy is observed: about 50% of the translational energy of the plasma particles is converted to Larmor rotational energy. The present paper gives the results of the interaction with similar periodic fields of considerably higher density (10^{20} - 10^{21} m⁻³)

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L 15141-65

ACCESSION NR: AP4045271

plasma bursts. At such densities, collision processes should play a significant role. Moreover, for high values of the ratio $\beta = nkT_i/B^2/8$ the modulating magnetic field should not penetrate to any appreciable depth into the plasmoid. Thus, it is difficult to predict the experimental results beforehand. The setup is diagramed in the figure (Enclosure). The main magnetic field ($B_0 = 0.2$ weber/m²) is spatially modulated by a series of coils with each successive pair connected in opposition (8.5 periods of 10 cm each); at the end of the cylindrical chamber is a magnetic mirror ($B_m = 0.05$ to 0.4 weber/m²). In the experiments B_m/B_0 was less than 4.0-4.5. The purpose of the experiments was to obtain evidence indicating resonance interaction of the plasma bursts with the spatially periodic magnetic field; this was done by recording the mass spectra of the protons in the wake after their passage through the modulated field at different ratios of the main field to the peak modulated fields. The results are presented in figures: proton energy spectra, variation in the relative number of 54 ev protons with variation in B_0 , and variation of the microwave blocking signal with B_0 . Resonance effects were observed and an explanation for them is proposed. It is suggested that an arrangement

Card 2/4

L 1511-65

ACCESSION NR: AP4045271

of this type can be used for containing plasma injected into a trap.
 "In conclusion, the authors express their deep gratitude to V.D.
 Fedorchenko and V.G. Safronov for interesting discussions in the
 course of the work." Orig. art. has: 1 formula and 2 figures.

ASSOCIATION: Fiziko-tekhnicheskii institut AN UkrSSR, Khar'kov
 (Physico-technical Institute, AN UkrSSR)

SUBMITTED: 15Jul63

ENCL: 01

SUB CODE: HE, EM

NO REF SOV: 006

OTHER: 000

Card 3/4

L 1511-65

ACCESSION NR: AP4045271

ENCLOSURE: 01

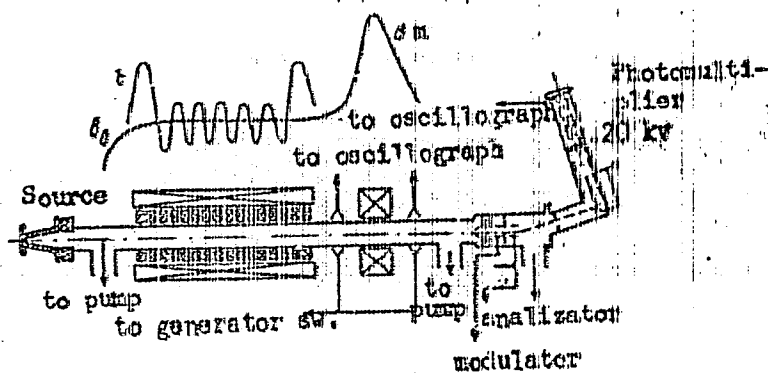


Fig. 1. Scheme of experimental installation

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L 1124-66 EWT(d)

ACCESSION NR: AP5016394

UR/0120/65/000/003/0196/0198

535.251.6:621.383.2.032.11

AUTHOR: Kalmykov, A. A.

TITLE: High-speed nonselective optic receiver 10

SOURCE: Pribery 1 tekhnika eksperimenta, no. 3, 1965, 196-198

TOPIC TAGS: optic receiver

ABSTRACT: A nonselective ("black") optic receiver has been designed with ordinary commercial photocells (TsV-3 and STSV-6); The receiver functions within 250--300 nm and is intended for oscillographic work. The receiver sensitivity is 1.3×10^{-4} amp/w, with an 8-mm² inlet aperture. The sensitivity is constant within $\pm(5-7)\%$ in the entire waveband, which permits determining temperature of "black" radiators with an error of $\pm 2\%$. The receiver can record luminous fluxes having a rise time of 10^{-6} sec or less. The temperature of the spark discharge in an EV-39 pulsed light source and the total energy flux associated therewith were measured with the above receiver; the results were found in good agreement with the nameplate ratings of the source. Orig. art. has: 4 figures.

Card 1/2

L 1124-66

ACCESSION NR: AP5016394

ASSOCIATION: Institut fiziki zemli AN SSSR, Moscow (Institute of Earth Physics,
AN SSSR)

SUBMITTED: 03 Oct 63

ENCL: 00

SUB CODE: 0P, EC

NO REF SOV: 000

OTHER: 002

Card 2/2

L 24049-66 EWT(1)/ETC(f)/EPF(n)-2/ENG(m) IJP(c) GS/AT/CN

ACC NR: AT6008845

SOURCE CODE: UR/0000/65/000/000/0078/0086

AUTHOR: Kalmykov, A. A.; Trubchaninov, S. A.; Naboka, V. A.

ORG: none

TITLE: Interaction between plasmoids of a magnetic field of acute-angled geometry

SOURCE: AN UkrSSR. Magnitnyye lovushki (Magnetic traps). Kiev, Naukova dumka, 1965, 78-86

TOPIC TAGS: magnetic field, plasmoid, magnetic trap, magnetic field intensity

ABSTRACT: The authors study ^{2/}capture of a plasma in an ^{2/}acute-angled trap using methods which permit measurements for particles with various energies for a more detailed investigation of the mechanism responsible for the interaction between a plasmoid and a magnetic field of acute-angled geometry. The acute-angled magnetic field was produced by the appropriate connection of two coils. Maximum field intensity was approximately 6000 oersteds. A drift spectrometer and a plasmascope were used for an experimental investigation of the plasma emerging from the trap. It was found that paraxial ions escape from the trap along the axis, i. e. ions which are in motion in the region near the axis and make an extremely small angle with the axis. The energy spectra of hydrogen ions from plasmoids after passage through a magnetic field of acute-angled geometry were compared with similar spectra for ions after passage through—

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ACC NR: AT6008845

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a homogeneous magnetic field of the same intensity. It was found that the acute-angled field cuts off the high energy ions. Energy spectra are also given for plasmoid protons after emergence from an acute-angled trap as a function of magnetic field strength. These curves show a reduction in the number of ions passing through the trap as the magnetic field strength is increased. An analysis of the experimental plasmograms shows that the plasma is initially pinched as it enters the trap and that the central part of the plasma then moves along the axis. A halo forms around this dense central section with a radius which increases with motion along the axis in spite of a simultaneous increase in the magnetic field intensity. The generation of this halo and the increase in its diameter may be due to rotation caused by some mechanism which converts the longitudinal edge component to a transverse component. The experimental data show that the leading edge of an acute-angled plasmoid is not captured and passes through the end of the trap. A more detailed study of the interaction between plasmoids and an axially symmetric magnetic field is needed for determining conditions necessary for trapping a fast plasma. Orig. art. has: 4 figures.

SUB CODE: 20/

SUBM DATE: 200ct65/

ORIG REF: 007/

OTH REF: 001

Card 2/2 dda

I 26973-65 ENT(1)/EPA(sp)-2/T/ECG(t)/EPA(w)-2/ENA(m)-2
 FI-4 IJP(c) AT S/0057/65/035/001/0163/0174
 ACCESSION NR: AP5003259

AUTHOR: Kalmykov, A.A. / Trubcheninov, S.A. / Naboka, V.A.

TITLE: On development of irritability in a plasma burst during its motion in a longitudinal magnetic field

SOURCE: Zhurnal tekhnicheskoy fiziki, v.35, no.1, 1965, 169-173

TOPIC TAGS: plasma, plasma instability, plasma injection, plasma rotation, magnetic mirror

ABSTRACT: Plasma bursts from a coaxial plasma gun fired by the 15 kV discharge of a 12 microfarad capacitor bank were observed with a "plasmascopes" as they moved in a (not always uniform) longitudinal magnetic field. The purpose of the observations was to investigate such instabilities of the plasma bursts as might develop. When a plasma burst traversed a magnetic barrier in which the field strength increased to a maximum value of 1600 Oe and decreased again to a low value in a distance of 50 cm, the core of the burst decreased in size but a halo of presumably less dense plasma formed and grew. At certain values of the magnetic field a spiral protuberance formed and increased in size. Such protuberances continued to develop when the

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ACCESSION NR: AP5003259

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plasma burst was moving in a uniform field. The direction of the spiral protuberance depended on the direction of the magnetic field and corresponded to a rotation of the plasma in the direction of the Larmor rotation of the ions. The observed instability is believed to be of the Rayleigh-Taylor type and a consequence of rotation of the plasma burst. The cause of the plasma rotation is not known, but drift forces due to the crossed fields resulting from uncompensated space charge in the plasma may be involved. The instability develops under a wide variety of conditions and is expected to complicate the problem of injecting plasma into a magnetic mirror system. In conclusion I express my gratitude to B.G. Saffronov for his interest in the work and for fruitful discussions." Orig. art. has: 2 figures.

ASSOCIATION: Fiziko-tekhnicheskii Institut AN UkrSSR, Khar'kov (Physicotechnical Institute, AN UkrSSR)

SUBMITTED: 09Mar64

ENCL: 00

SUB CODE: MB

NR REF SCY: 005

OTHER: 008

Card 2/2

L 51972-65 EWP(1)/EWP(m)/EPF(c)/EPF(n)-2/ENG(m)/EPA(w)-2/EWP(t)/EWP(b)

P2-6, P2-4 Feb-10/Pr-4 P1-4 JIP-1 JD/WG/AT

ACCESSION NR: AP501205

UR/00513R000620130004-5

AUTHOR: Timofeyev, A.D.; Marinin, V.G.; Shevchuk, B.A.; Kalmykov, A.N.

TITLE: Investigation of the operation of a coaxial plasma source under conditions of fast particle production

SOURCE: Zhurnal tekhnicheskoy fiziki, v. 35, no. 5, 1965, 848-864

TOPIC TAGS: plasma, plasma source, plasma acceleration, ion distribution, hydrogen, iron, helium

ABSTRACT: The operation of a coaxial plasma source was investigated experimentally. The stainless steel cylindrical electrodes were 5.4 and 2 cm in diameter, and the outer electrode was 25 cm long. After admission of 0.9 cm^3 of He for 10 sec

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L 51974-05
ACCESSION NR: AP5012050

admission and firing of a coaxial plasma source is less than a certain critical
value. The value of the critical current for the present apparatus is 1.5 A. The
critical current is a function of the plasma density and the velocity of the

Card 2/3

L 51972-65
ACCESSION NR: AP5012050

kinetic energy of the plasma. "In conclusion, I express my gratitude to B. I. Safronov for his interest in the work and for fruitful discussions." Orig. art. has: 3 formulas and 5 figures.

ASSOCIATION: None

SUBMITTED: 26Jun64

ENCL: 00

SUB CODE: ME

NR REF SCV: 006

OTHER: 002

Card 3/3

L 05787-67 EWT(1) IJP(c) AT

ACC NR: AT6033190

SOURCE CODE: UR/3137/65/000/270/0001/0020

AUTHOR: Khizhnyak, N. A. ; Kalmykov, A. A. ; Trubchaninov, S. A. ;
Naboka, V. A.

54
51
B+1

ORG: none

TITLE: On the adiabatic ²movement of plasma beams in a longitudinal magnetic field

SOURCE: AN UkrSSR. Fiziko-tekhnicheskiy institut, Doklady, no. 270/R057,
1965. K voprosu ob adiabatichnosti dvizheniya plazmennyykh sgustkov v prodol'nom
magnitnom pole, 1-20

TOPIC TAGS: plasma beam, longitudinal magnetic field, plasma density

ABSTRACT: The author discusses the entry mechanism of small plasma beams into an axially symmetrical magnetic field, depending on the particle density in the beam. The deductions from the theory are compared with an experimental study of magnetic moments of low- and high-density plasma beams. The experiments are found to agree with the theory on the substantial influence of plasma density on the magnetic moment of the plasma beam, and with the theory of the

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L 05787-57

ACC NR: AT6033190

dynamic interaction of beams with an axially symmetrical magnetic field. The model of a generalized current loop used in calculations can therefore be considered a satisfactory approximation of the description of plasma beams. In conclusion, the authors express their deep gratitude to K. D. Sinel'nikov, academician of the AN USSR, and to B. G. Safronov and V. S. Komel'kov for fruitful discussions which stimulated this work in many ways. Orig. art. has: 7 figures and 30 formulas.

SUB CODE: 20/ SUBM DATE: none/ ORIG REF: 013/ OTH REF: 006/

Card 2/2 *eqv*

L 43911-66 EWT(1 IJP(c) GD/AT
ACC NR: AT6020406 (N)

SOURCE CODE: UR/0000/65/000/000/0089/0102

AUTHOR: Kalmykov, A. A.; Trubchaninov, S. A.; Naboka, V. A.

ORG: none

TITLE: Development of instability in a plasmoid upon injection in an axially-symmetrical magnetic field

SOURCE: AN UkrSSR. Issledovaniye plazmennyykh sgustkov (Study of plasma clusters). Kiev, Naukova dumka, 1965, 89-102

TOPIC TAGS: plasmoid, plasma instability, plasma injection, plasma diagnostics, magnetic pinch, magnetic mirror

ABSTRACT: The present investigations were made with a coaxial plasma gun which produced hydrogen plasmoids of density up to 10^{13} cm^{-3} and velocities $(7-8) \times 10^7 \text{ cm/sec}$ (Fig. 1). The magnetic field was produced at a distance (100 cm) sufficient for attenuation of the currents captured by the plasmoid. In view of the fact that the front part of the plasmoid did not have sufficient luminosity, the structure of the plasmoid was investigated with a plasmascop first described by L. A. Yelizarov and A. V. Zharinov (Nucl. Fus. 1962, suppl. 2, 699). The field distribution was measured with the aid of probes. The results showed that the behavior of the plasmoids in the non-uniform magnetic field was very similar to that occurring during rapid compression of the plasma in a θ pinch, and the test results are interpreted in light of this phenomenon. The possible causes of the instability of the plasmoid upon enter-

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ACC NR: AT6020406

ing the axially-symmetrical field are discussed and are found to consist of reflection of part of the electrons on entering the magnetic field and the development of a radial electric field. It was also noted that the injection can be accompanied by rotation of the plasma, which may hinder the injection of plasma in magnetic traps of either mirror or acute-angle geometry. Orig. art. has: 9 figures and 3 formulas.

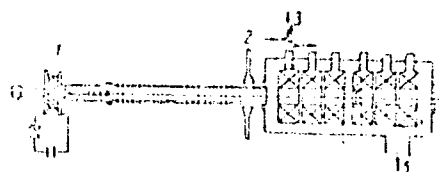


Fig. 1. Diagram of experimental setup: 1 - Plasma gun, 2 - microwave horn antennas, 3 - magnetic field coils, 4 - plasmascope, 5 - vacuum.

SUB CODE: 20/ SUBM DATE: 11Nov65/ ORIG REF: 005/ OTH REF: 008

Card 2/2 *lgm*

L 41065-66 EWT(1) IJP(c) GD/AT
ACC NR: AT6020408 (N)

SOURCE CODE: UR/0000/65/000/000/0112/0118

AUTHOR: Kalmykov, A. A.; Tereshin, V. I.; Chebotarev, V. V.

ORG: none

TITLE: Stabilization of plasmoid boundaries in the traversal of corrugated magnetic fields

SOURCE: AN UkrSSR. Issledovaniye plazmennyykh sgustkov (Study of plasma clusters).
Kiev, Naukova dumka, 1965, 112-118

TOPIC TAGS: plasmoid, plasma magnetic field, plasma velocity, plasma stability

ABSTRACT: The results in this work indicate that corrugated magnetic guiding fields can replace high frequency stabilization of a plasmoid surface. The period of corrugation in the guiding fields was 10 cm, which at a plasma velocity of $2 \cdot 10^7$ cm/sec corresponded to a frequency of 2 Mc. The modulation amplitude was about 15%--sufficient to stabilize the instability leading to a spiraling of the plasma. This is demonstrated by a plasmascoppe adapted for pulsed operation. When the modulation amplitude reached 25% of the constant guiding field, some assymetry of plasma boundary was observed. At higher plasma velocity, the corrugated field failed to stabilize the plasma and tongue-like protuberances were observed. Energy loss measurements show that some 20% of the energy remained in the plasmoid for long travel distance. This, the authors

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L 41065-66

ACC NR: AT6020408

ascribe to the stabilization of those parts of the plasmoid which satisfy stability conditions in the corrugated field, whereas the remaining plasma was lost to the walls. Orig. art. has: 3 figures.

SUB CODE: 20/

SUBM DATE: 11Nov65/

ORIG REF: 007/

OTH REF: 002

Card 2/2 *ldh*

L 41004-66 EWT(1) IJP(c) GD/AT
ACC NR: AT6020407 (N)

SOURCE CODE: UR/0000/65/000/000/0103/0111

AUTHOR: Kalmykov, A. A.; Tereshin, V. I.; Chebotarev, V. V.

ORG: none

TITLE: Traversal of a spatially nonuniform magnetic field by plasmoids

SOURCE: AN UkrSSR. Issledovaniye plazmennyykh agustkov (Study of plasma clusters).
Kiev, Naukovo dumka, 1965, 103-111

TOPIC TAGS: plasmoid, plasma magnetic field, ~~plasma scope~~, plasma conductivity, spectroscopy

ABSTRACT: ³Plasmoid motion in a nonuniform magnetic field is studied with particular emphasis on the blocking of the slow-moving tail part which carries a large amount of impurities and is not strongly ionized. Periodic space perturbation of magnetic field was introduced in such a way that the high conductivity pure part of the plasmoid was not greatly affected, while the cooler tail end interacted strongly with the field. These experiments were performed on straight sections of a plasma guide using magnetic probes, spectroscopy and a pulsed plasmascope for the study of plasmoid properties. Magnetic probes showed the almost complete expulsion of the magnetic field by the fast ($5 \cdot 10^6$ cm/sec) portion of the plasmoid. These measurements were used to determine the extent of a high-conductivity plasmoid as its position in the guide changed. It was

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ACC NR: AT6020407

shown that as the amplitude of the nonuniform field increased, the upper limit on the ion velocity moved toward lower speeds. It was further shown that the greatest losses of the high conductivity part of the plasmoid was due to particles following force lines toward the vessel walls. The plasmoid component which propagates best in such fields was that for which the conditions of high frequency stabilization are met, provided the appropriate space-modulation oscillation replaces the stabilizing frequency. Orig. art. has: 6 figures, 1 formula.

SUB CODE: 20/

SUBM DATE: 11Nov65/

ORIG REF: 004/

OTH REF: 001

Card 2/2 *lkh*

L 43799-66 ENT(1)/T IJP(c) AT/JGS/GD
ACC NR: AT6020415 (N)

SOURCE CODE: UR/0000/65/000/000/0172/0181

AUTHOR: Kalmykov, A. A.; Pankrat'yev, Yu. I.; Nozdrachev, M. G.; Shevchuk, B. A.
ORG: none

TITLE: Investigation of a discharge in a pulsed plasma source

SOURCE: AN UkrSSR. Issledovaniye plazmennykh sgustkov (Study of plasma clusters).
Kiev, Naukovo dumka, 1965, 172-181

TOPIC TAGS: plasma source, plasma gun, pulsed magnetic field, ion acceleration, mass spectroscopy, high speed photography

ABSTRACT: The performance and characteristics of a plasma gun with a hot cathode are studied. The gun structure and operational parameters are described. The gun was operated with a pulsed magnetic field (20 μ sec) during which a much shorter high voltage pulse was applied to the cathode which was found to eject both ions and electrons. The collector received about one ampere of ion current during such pulsed operations. As in other guns, the ion acceleration occurred only during the first few tenths of a microsecond and the energy reached often exceeded the applied accelerating voltage. It was noted that when artificial transmission lines were used for the energy storage plasma ejection occurred at each reflection of the wave thus forming a long train of plasmoids. The plasma properties were studied with a mass spectrometer, x-ray detec-

Card 1/2

L 43799-66

ACC NR: AT6020415

tors and high speed photography. The results for various pressure and current conditions are shown and analyzed in terms of the electric circuit interaction with a simple plasma model. Orig. art. has: 4 formulas, 7 figures.

SUB CODE: 20/

SUBM DATE: 11Nov65/

ORIG REF: 006/

OTH REF: 005

Card 2/2 PB

ACC NR: AP7000045

SOURCE CODE: UR/0207/66/000/005/0003/0016

AUTHOR: Kalmykov, A. A. (Moscow); Kondrat'yev, V. N. (Moscow); Nemchinov, I. V. (Moscow)

ORG: none

TITLE: The disintegration of an instantaneously heated substance and determination of the equation of state by the pressure and momentum

SOURCE: Zhurnal prikladnoy mekhaniki i tekhnicheskoy fiziki, no. 5, 1966, 3-16

TOPIC TAGS: state equation, dispersion equation, heating

ABSTRACT: A study was made of the pattern of separation of fragments of a substance heated "instantaneously" by the radiation of a laser, i.e., in a period of time considerably shorter than the characteristic time of separation. Thermodynamic functions describing the state of the substance at high pressures and high temperatures but at normal (or near-normal) density ρ_0 were investigated. Such states can be obtained by "instantaneous" heating of the substance ($\rho = \rho_0$) and its subsequent separation ($\rho < \rho_0$). When the layer of the substance is heated to values of intrinsic energies much smaller than the value of the evaporation heat, a portion of the substance separates as the result of the interaction of rarefaction waves and the formation of negative stresses. The dependence of momentum in the presence of the "splitting-off" effect on the quantity of supplied energy and the thermodynamic

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properties of the substance was found for cases of uniform and nonuniform heating. During interaction between the laser emission and a sufficiently thick layer of the substance, the radiation flux decreases with the penetration depth as the result of absorption. The mass of the separated layer has little effect on the magnitude of the momentum. The value of momentum is the sum of the momentum of that layer of the substance which is heated to a gaseous state and the momentum of that layer of the substance which is partially evaporated or crushed, assuming that these values do not depend on each other. The authors thank I. L. Zel'manov, A. I. Petrukhin, and Ye. Rabinovich for valuable discussions. Orig. art. has: 35 formulas and 10 figures.

SUB CODE: 20/ SUBM DATE: 26Apr66/ ORIG REF: 009/ ATD PRESS: 5108

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L 11428-67 EWT(1)/EWT(m) IJP(c.)
 ACC NR: AP6021263 SOURCE CODE: UR/0057/66/036/009/1608/1621
 AUTHOR: Khizhnyak, N.A.; Kalmykov, A.A.
 ORG: none
 TITLE: Dynamics of the current sheet and acceleration of plasma in an electrodynamic rail accelerator
 SOURCE: Zhurnal tekhnicheskoy fiziki, v. 36, no. 9, 1966, 1608-1621
 TOPIC TAGS: plasma gun, plasma acceleration, electromagnetic effect, mathematic physics
 ABSTRACT: The authors discuss the production and acceleration of plasma in a rail accelerator having plane parallel electrodes. The problem is treated in one dimension, all quantities being assumed to depend only on the time and on one Cartesian coordinate, whose axis is parallel to the two electrodes and perpendicular to the electron current sheet, which is assumed to be initially present. The inertia of the electrons is neglected, and it is assumed that the electron Larmor radius is small compared with the electrode spacing. The electron motions are thus treated in the drift approximation when the plasma is rarefied, and with the effect of the Hall currents included when the plasma is dense. Ions are assumed to be formed in the current sheet and to lag behind, thus producing a longitudinal polarization field. It is shown that the form and magnitude of the polarization field play decisive roles in the shaping and
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acceleration of the plasma burst. To calculate the polarization field, the motion of the ions is described by the kinetic equation with a term representing the production of ions in the forward current sheet, and several simplifying assumptions are introduced, including the assumptions that the current sheet is thin and moves with constant velocity. It is shown that the polarization gives rise to longitudinal electrostatic waves in the plasma, and that as a result of these oscillations there are formed many closed current loops. An equation is derived relating the velocity of the center of mass of the plasma to that of the current sheet. The electrodynamic acceleration of the center of mass is described by equations similar to those of L.A. Artsimovich, C.Yu.Luk'yanov, I.P.Podgorny, and S.A.Chuvatin (ZhETF, 33, 3, 1957) until the energy begins to be expended in the production of electrostatic oscillations. Whereas the energy of the plasma as a whole is determined by the total discharge current, the energy spectrum of the plasma particles depends significantly on the distribution of the current within the plasma. It is found that there is an optimum self-inductance for maximum acceleration efficiency, below which it is not desirable to reduce the parasitic inductance of the circuit. The authors thank K.D.Sinelnikov, V.S.Komel'kov, A.I.Morozov, A.A.Rukhadze, B.G.Safronov, and M.I.Pergament for many fruitful discussions. Orig. art. has: 82 formulas and 1 figure.

SUB CODE: 20

SUBM DATE: --Sep66

ORIG. REF: 007

OTH REF: 011

Card 2/2 bab

ACC NR: AP6031269

SOURCE CODE: UR/0057/66/036/009/1652/1664

AUTHOR: Khizhnyak, N.A.; Kalmykov, A.A.; Trubchaninov, S.A.; Naboka, V.A.

ORG: none

TITLE: On the adiabaticity of the motion of plasma bursts in longitudinal magnetic fields

SOURCE: Zhurnal tekhnicheskoy fiziki, v. 36, no. 9, 1966, 1652-1664

TOPIC TAGS: hydrogen plasma, dense plasma, rarefied plasma, plasma dynamics, adiabatic process, plasma magnetic field, nonhomogeneous magnetic field, magnetic moment

ABSTRACT: This paper is concerned with the motion of plasma bursts along the axis of a longitudinally inhomogeneous axially symmetric magnetic field. The pliant current loop model, developed in a series of articles by N.A. Khizhnyak, V.G. Safronov, and K.D. Sinel'nikov (Sb. "Fizika plazmy i problemy upravlyayemogo termoyadernogo sinteza", t. I. Izd-vo AN UkrSSR, Kiyev, 1963; ibid. t. II, 1964; ZhTF, 35, 827, 1965; ZhTF, 35, 833, 1965), is generalized to take into account changes in the shape of the plasma. Equations of motion are derived under the simplifying assumptions that the deformation of the plasma is small, the plasma remains spheroidal (but may become either prolate or oblate), and the thermal expansion of the plasma during its interaction with the magnetic field is negligible. Particular attention is given to the magnetic moment of the plasma burst as a criterion of the adiabaticity of its motion. For a low density

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plasma, the equations of the generalized pliant current loop model reduce to those of the independent particle model and the magnetic moment should remain constant as long as the usual adiabaticity condition is met. The magnetic moment of a dense plasma, on the other hand, should increase as the plasma moves into regions of higher magnetic field strength until it encounters a magnetic field of a critical strength, when the plasma should collapse and its magnetic moment should decrease rapidly. The theoretical predictions were tested experimentally. Hydrogen plasma bursts from a coaxial plasma gun, after traversing a 1 m long drift tube, entered the field of a series of six 17 cm long 8 cm inner diameter direct current solenoids, each capable of producing a 10 kOe field. The magnetic moments of the plasmas were measured with the aid of an external loop and internal magnetic probes that could be adjusted in the radial direction. The densities of the plasmas were determined with a shielded electrical probe, by cutoff of 3 and 0.8 cm microwaves, and with a 3 cm wavelength interferometer. The plasmas were found to behave in accordance with the theory. In particular, the magnetic moments of the plasmas with densities below 10^{12} cm^{-3} remained constant until fields of the critical strength were encountered and then decreased monotonically and fairly rapidly, whereas the magnetic moments of the plasmas with densities above 10^{14} cm^{-3} increased as the plasmas moved into regions of higher field strength, even though the independent particle adiabaticity condition was better satisfied by the high density plasmas than by the low density ones. It is concluded that the generalized current loop model provides a rather good approximate description of the behavior of plasma bursts. The work of several other investigators is discussed in the light of the present theory, and it is concluded that the plasma entrapment mechanism proposed

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by J.L.Tuck (Phys. Rev. Lett., 3, 317, 1959) can be effective only under such conditions that the plasma traverses the magnetic field gradient region in a time shorter than the collapse time of the plasma, which is approximately the ratio of the plasma circumference to the Alfvén velocity. The authors thank B.G.Safronov, V.S.Komel'kov, and Academician K.D.Sinell'nikov of the AN UkrSSR for fruitful discussions. Orig. art. has: 38 formulas and 7 figures.

SUB CODE: 20

SUBM DATE: 04Sept65

ORIG. REF: 011

OTH REF: 008

Card 3/3 bab

ACC NR: AP7003249 (A) SOURCE CODE: UR/0207/66/000/006/0003/0013

AUTHOR: Kalmykov, A.A.; Nemchinov, I.V.; Petrukhin, A.I.

ORG: none

TITLE: Experimental investigation of the scattering of an instantaneously heated substance and the appearance of momentum at energy concentrations smaller than the heat of evaporation

SOURCE: Zhurnal prikladnoy mekhaniki i tekhnicheskoy fiziki, no. 6, 1966, 3-13

TOPIC TAGS: laser heating, laser effect, ice, paraffin, LASER RADIATION, HEAT OF VAPORIZATION

ABSTRACT:

High-speed photography was used in an investigation of the scattering of a substance heated by laser radiation. The substances selected were ice and paraffin which were rapidly heated by a giant-pulse ruby laser to an energy concentration smaller than the heat of evaporation Q . The pulse duration at the half flux was $\tau = 2 \times 10^{-8}$ sec. The rate of scattering of the substance was determined by means of a high-speed photo-chamber with a maximum speed of 5×10^7 frames per second. The splitting-off was accompanied by momentum, which was generated by the scattering of the substance. The

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UDC: none

ACC NR: AP7003249

release of energy E_T in a surface layer with a thickness x_T or mass m_T in a time $\tau < t_g$ (characteristic time of gasdynamic processes $t_g = x_T/c$, where c is the sonic velocity in the substance), resulted in the appearance of a pressure $p_0 = (\gamma - 1)E_T/x_T$ in that layer. The closing up of rarefaction waves propagating from the boundary of the heated layer led to the appearance of negative stresses. When these stresses exceeded the dynamic tensile strength of the substance, a splitting-off took place. The maximum coefficient of energy utilization $\xi = I/Q/E$ was found to be at an energy concentration in a unit of mass close to Q and lower, and can reach values close to maximum values at high energy concentrations (above the heat of evaporation). The authors thank their laboratory colleagues Ya. T. Goyevoy and B. M. Zubenko and V. S. Savinich, a student at the Moscow Physicotechnical Institute, for their help in the work. [JA]

SUI CODE: 20/ SUBM DATE: 02Jun66/ ORIG REF: 011/ OTH REF: 001
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